TECHNICAL MANUAL

USE OF DYE IN TURBINE FUELS (JP-4, JP-5, AND JP-8) TO DETECT FUEL SYSTEM LEAKS

(ATOS)

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INTRODUCTION

1. PURPOSE.

This technical manual provides information on the preparation and use of dyed fuel to detect fuel system leaks in aircraft using turbine fuels (JP-4, JP-5, and JP-8).

2. SCOPE.

This manual provides information for using dyed fuel to check for leaks in the fuel system including fuel cells and engine lines. The correct procedure for leak detection is provided along with the applicable specification and National Stock Number (NSN) used to order the liquid dye from supply. Approved disposal procedures are also provided.

3. SAFETY.

WARNING

Personnel must provide adequate ventilation when mixing dye in fuel tanks. Ventilation will remove the highly flammable and toxic solvent vapors during the mixing process that may be harmful to personnel.

Liquid fuel dye should be treated with the same precautions as applied to the specific turbine fuel being used. Applicable regulations regarding the use of flammable materials and tank entry must be followed at all times while using dyed fuel.

4. IDENTIFICATION OF TURBINE FUELS.

Fuel dye will not be used for the identification of turbine fuels.

CHAPTER 1
PREPARATION OF DYE SOLUTION

1.1 APPLICATION.

The dye is to be pre-mixed with turbine fuel only by the activity responsible for detecting and repairing aircraft fuel system leaks.

1.2 STATIC AND IN-FLIGHT LEAK CHECKS.

1.2.1 Static Leak Checks. Dyed fuel may be used for static leak detection of fuel cells and complete fuel systems.

1.2.2 In-Flight Leak Checks. In-flight tests to find leaks that cannot be detected by static or engine run-up tests may be used with special approval of the prime aircraft ALC. Stocks of fuel will not be dyed locally for use in conducting continuous in-flight leak detection evaluations. The Base Commander or other Local Base Aircraft Command Agency, in coordination with the aircraft prime activity (specified in D086), may authorize periodic in-flight use of dyed fuel when flight tests are essential for leak detection. Yellow or green fluorescent-dyed fuel will be used for in-flight testing at the concentrations specified in Table 1-1.

NOTE

Red dye is no longer authorized as leak detection dye due to operational and safety problems associated with its use.

1.2.3 Liquid Dye Stock Numbers. Stock numbers for the liquid dyes are as follows:

a. NSN 6820-00-787-5258 – Dye, Yellow, for Detection of Leaks in Aircraft Fuel Systems, MIL-D-81928 – Type II – 30 Gallons

b. NSN 6820-01-386-8609 – Dye, Green Fluorescent, for Detection of Leaks in Aircraft Fuel Systems, MIL-D-81298 – Type III – 1 Gallon

Table 1-1. Preparation of Dye Solution

Static Fuel System Tests	
Liquid Dye	Mixing Ratio
Yellow and Green Fluorescent	Add 2.0 ounces (wt) to each 100 gallons of fuel
In-flight Fuel System Tests	
Liquid Dye	Mixing Ratio
Yellow and Green Fluorescent	Add 1.6 ounces (wt) to each 100 gallons of fuel

CHAPTER 2
LEAK DETECTION IN FUEL CELLS

2.1 LIQUID DYE PREPARATION.

2.1.1 Mixing Liquid Dye with Turbine Fuel in the Fuel Cell. Use the following procedure to mix liquid dye with turbine fuel in fuel cells

a. Put about one fourth of the amount of fuel to be used for the first check into the fuel cell.

b. Add the required amount of dye (see Table 1-1) for each 100 gallons of fuel that will be used and then add the rest of the fuel. An example for checking a 300-gallon capacity cell follows:

(1) Add 25 gallons of fuel.

(2) Add the required amount of liquid dye.

(3) Add 75 gallons of fuel.

(4) Make leak check.

(5) Add the required amount of liquid dye.

(6) Add 100 gallons of fuel.

(7) Make leak check.

(8) Add the required amount of liquid dye.

(9) Add 100 gallons of fuel.

(10) Make final leak check.

2.1.2 Mixing Liquid Dye with Turbine Fuel in a Service Vehicle. The dye should be blended in a refueling vehicle that has been reserved for servicing dyed fuel. The required quantity of dye should be determined prior to mixing. To insure proper mixing of dye in the fuel, partially fill the trailer to about 10 percent of capacity and then add the appropriate amount of dye slowly to the contents of the trailer while the trailer is filled with the remaining fuel. After completion of the fuel cell leak detection operation, the aircraft may be flown with the dyed fuel provided it is diluted 10 to 1 with undyed fuel in the fuel cell or fuel cells. If dilution is not possible, the aircraft will be defueled of dyed fuel. The dyed fuel will be stored in a marked bulk storage tank as instructed in Chapter 4.

2.2 LEAK DETECTION PROCEDURE.

a. Use a diagram of the leaking fuel cell that shows all connections. Check external fittings as the possible source of leakage.

b. Transfer the fuel into another cell or defuel as necessary. Fill the leaking cell to one third of its capacity with turbine fuel. Add the liquid dye as required by Table 1-1.

NOTE

One third capacity level point is determined from the known capacity of the cell. For example, 100 gallons would be added to a 300-gallon cell.

c. Allow the dyed fuel to remain in the cell for approximately six hours or until the dyed fuel comes through the drain. Should the dye appear, there is a leak in the cell below the fuel line.

d. Repeat the procedure set forth in the preceding steps of this paragraph with the cell filled to the two thirds capacity level and then with the cell at the full level if necessary. A full cell should be allowed to soak for approximately 12 hours.

e. When a leak is detected connections should be checked, the cell defueled and residual fuel removed with cloths and drained from the sump. A Type MA-1 explosion-proof blower may be used to remove fumes. Remove all connections, pull the fuel cell down and check for dye stains on the exterior of the cell. These stains are easily detected to show the location of the leak. Rarely is any maintenance necessary other than replacing seals and making sure connections are tight.

CAUTION

The addition of liquid dyes directly to the fuel cells may cause deterioration of the lining (blisters, layer separation or other damage).

f. Check for defective cells (blisters, layer separations or other damage) in accordance with the applicable fuel cell or aircraft maintenance manual.

g. After closing the fuel cell, the dye solution may be transferred back into the fuel cell to the three levels (one third, two thirds, and full) once more to verify that the leak is repaired.

CHAPTER 3
PROCEDURE FOR FUEL SYSTEM LEAK CHECKS INCLUDING ENGINE LINES

3.1 FUEL SYSTEM LEAK CHECKS.

This chapter provides information for using dyed fuel to check for fuel leaks at the fuel system's supply and transfer line couplings, at the integral wing cell panel joints, and at engine mounted fuel line fittings under dynamic conditions. The dyed fuel is particularly useful in checking for leakage near the engine hot section area. These areas include the afterburner pigtail couplings or where high temperatures prevent leaking fuel from leaving a wet spot. When the dyed fuel evaporates from a surface, the dye remains as a deposited residue.

3.1.1 Dye Colors. Yellow or green fluorescent-dyed fuel may be used for engine run-up testing on the ground after an engine change or for test flights after a periodic or phased inspection. After completion of testing the residual yellow or green fluorescent-dyed fuel need not be removed from the aircraft.

3.1.2 Leakage Tests. Leakage checks of airframe mounted lines and connectors, and of integral wing and auxiliary fuel tanks may be undertaken using any of the dyes authorized herein. Residual yellow or green fluorescent-dyed fuel need not be removed.

3.2 PREPARATION FOR TESTING.

a. Determine the quantity of fuel required for static tests, flight tests, or engine run-up as applicable.

b. Start with an empty refueling truck. Add approximately one third of the required quantity of fuel. Add the liquid dye in the concentration shown in Table 1-1. Finish adding fuel to the truck.

c. Supply dyed fuel to the aircraft through the single point refueling receptacle as instructed in the applicable aircraft technical order.

3.3 FUEL SYSTEM LEAK CHECK PROCEDURE.

If engine run-up or test flight is programmed, the leakage test may be conducted any time after the aircraft has been fueled. If only the airframe mounted fuel lines and connectors, integral wing fuel cells, or auxiliary fuel cells are to be tested, allow the dyed fuel to stand in the aircraft six to eight hours before performing leakage testing.

3.3.1 Engine Mounted Lines and Connectors.

a. Perform the engine run-up or test flight in accordance with applicable directives.

b. Upon completion of the engine run carefully examine the main fuel line shutoff valve connections and all other connectors downstream of it. Examine the afterburner pigtail connections. Any visible dye deposit indicates leakage.

3.3.2 Airframe Mounted Lines and Connectors.

a. Examine all accessible fuel cell interconnects, fuel cell access covers, drains, boost pump mounting points, and fuel line connections. Follow periodic inspection instructions given in applicable aircraft maintenance technical orders.

b. If the aircraft has not had an engine run-up, operate the fuel boost pumps while keeping the main fuel shutoff valve closed. Check for leaks in the lines upstream of the main fuel shutoff valve.

3.3.3 Integral Wing and Auxiliary Fuel Tanks.

a. Examine wing cell panel joints, fasteners and access covers for visible dye deposits.

b. Examine auxiliary tank joints, fittings, and line couplings for dye deposits.

3.3.4 Leak Repair. After the leak has been repaired, remove the dye stain and repeat the applicable test. Recheck repaired areas to verify that leakage has stopped.

CHAPTER 4
DISPOSITION OF DYED FUEL

4.1 DISPOSAL PROCEDURES.

Dyed turbine fuel will be disposed of using the following guidelines.

NOTE

Yellow-dyed fuel enhances and accelerates the growth of microorganisms and should not be stored for prolonged periods of time.

4.1.1 Bulk Storage. Turbine fuel dyed with yellow or green fluorescent dye may be left in the fuel system following leak detection operations and used in normal operations. Yellow or green fluorescent-dyed fuel that has been removed from the system may be placed in bulk storage. Dyed fuel may be used without dilution or mixed with other dyed fuel that has been diluted.

4.1.2 Storage Tank Identification. The bulk tank in which the dyed fuel is stored or mixed with standard fuel will be marked with signs 4" by 12", black letters on white background, which will be prepared using wood or similar material. The signs will read: THIS TANK CONTAINS LEAK DETECTION DYED FUEL. These signs will be temporarily attached to the receiving and issuing valves. When all of the dyed fuel has been issued the signs will be removed. This should be accomplished in order to avoid confusion with colored gasoline.

4.2 SERVICING TO TRANSIENT AND RECEIVER AIRCRAFT.

4.2.1 Approval to Fly. The approval to fly with dyed fuel is for the internal use of the affected aircraft only. Dyed fuel will not be serviced to transient aircraft. Locally assigned tanker aircraft flying with dyed fuel (diluted) shall not offload dyed fuel to a receiver aircraft.

4.2.2 Transient Aircraft. The presence of dyed fuel in transient aircraft could be falsely construed by the air crew and maintenance personnel as contaminated fuel. The crew will be advised if emergencies arise requiring servicing of dyed fuel to transient aircraft. A note will be made in the aircraft forms that the aircraft was serviced with dyed fuel.

4.2.3 Excess Liquid Dye Stain. Any excess liquid dye stain on the aircraft, fuel cell, or storage equipment may be removed by wiping with a cloth. The dye will lose color and fade in a short time. It is not necessary to take special measures to remove all stains.